A Handbook For Wetland Habitat Evaluation In Missouri

Missouri Department of Conservation

U.S. Soil Conservation Service, Columbia

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INTRODUCTION

In 1970, a task force composed of representatives from the Bureau of Sport Fisheries and Wildlife, now the Fish and Wildlife Service (FWS), state conservation agencies and private conservation groups recommended that the FWS develop a non-monetary evaluation procedure to quantify impacts on fish and wildlife from water resources projects. Existing monetary approaches considered only impacts to game species and were inadequate assessments of total project impacts. The system developed by Daniel and Lemaire (Wildlife Soc. Bull, 2(3): 114-118) for Missouri was modified by the FWS to meet the requirements of the Water Resources Council's Principles and Standards for Planning Water and Related Land Resources. The FWS published the Ecological Planning and Evaluation Procedures in 1974 as a non-monetary habitat assessment procedure and revised the document in 1976 (U.S. Fish and Wildlife Service, Division of Ecological Services. 1976. Habitat Evaluation Procedures. Washington, D.C. 30 pp.). By 1980, the FWS through the Western Energy and Land Use Team again revised the procedures, and established the 1980 Habitat Evaluation Procedures (U.S. Fish and Wildlife Service, Division of Ecological Services. 1980. Habitat Evaluation Procedures (HEP). ESM 102. Washington, D.C. 281 pp) or "1980 HEP" as the agency's official assessment planning tool.

Early efforts to develop a non-monetary habitat evaluation approach involved the Missouri Cooperative Wildlife Research Unit in cooperation with the FWS. In 1977, the Cooperative Research Unit published A Handbook For Habitat Evaluation Procedures (U.S. Fish and Wildlife Service, Resour. Publ. 132. 77 pp.) which proposed habitat criteria for objectively documenting and scoring habitat quality. This "Blue Handbook" was prepared to complement the 1976 FWS Habitat Evaluation Procedures. In 1980, revisions were made in the handbook and an expanded edition or the "Yellow Handbook" was published (U.S. Fish and Wildlife Service, Resour. Publ. 113. 155 pp). The "Yellow Handbook" also serves as a companion document for the FWS Habitat Evaluation Procedures. However, the new 1980 HEP system has again demonstrated the necessity for revising and updating a companion field handbook for Missouri.

The Habitat Evaluation Procedures are a habitat-based approach for assessing impacts on habitat quality of land or water management practices. The procedures document the quantity and quality of habitat for selected wildlife species. The HEP make two general types of wildlife habitat comparisons including (1) the relative value of different areas at the same point in time, and (2) the relative value of the same area at future points in time.

The 1980 HEP system is based on the assumption that habitat for selected wildlife species can be described by a habitat suitability index (HSI). This index, ranging from 0.1 to 1.0, is multiplied by area of available habitat to obtain habitat units (HU),

a measure of both habitat quality and quantity. The HSI is determined with the aid of species habitat models. The models provide a predictive capability by examining vegetative structural components or habitat characteristics of wildlife habitat. The HSI is a measure of how well habitat conditions compare to optimum conditions. With the HSI and HU concepts, planners can project impacts for many alternative management programs. Finally, mitigation decisions can be made by displaying potential habitat improvements for selected species, plus costs associated with management.

The "Yellow Handbook" contained habitat descriptions for 17 wildlife species called evaluation elements. The habitat descriptions are criteria that are used to score habitat quality by habitat type. The "Yellow Handbook" is, therefore, compatible with the 1980 HEP system and the evaluation elements can serve as the species habitat models. Experience with the "Yellow Handbook" produced significant changes, specifically including: (1) applicable area expanded from the 11-county central Missouri region to the agricultural areas of northern, west-central, and southwest Missouri; (2) additional species habitat models; (3) standardized terminology and field measurements between species habitat models; (4) different habitat types; (5) addition of field forms and description of sampling techniques; (6)description of data analysis procedures; and (7) improved recognition of limiting factors.

The "Yellow Handbook" was revised in 1983 and reprinted as A Handbook for Habitat Evaluation in Missouri (Urich et. al. Missouri Department of Conservation, Jefferson City, Mo. 148 pp). Twenty-one species models were described in this revised handbook.

The 1983 handbook was designed to strengthen the field aspect of the habitat evaluation procedures by providing key habitat characteristics in the form of species models for selected upland wildlife. The 1980 HEP system is designed as a consistent and repeatable procedure for evaluating existing conditions and projecting impacts. Models are a necessary feature for achieving consistency.

This wetland handbook presents species models for evaluating wetland habitat quality with 7 species and is issued as a companion document to the 1983 handbook. Species narratives and references are provided with each model as background for habitat characteristics and model design. Much of the life history, distribution and management information contained in the species narratives was extracted from Missouri's Fish and Wildlife Information System, a computer data base with information on the state's fish and wildlife species. This information system is maintained by the Missouri Department of Conservation, Wildlife Division, Jefferson City, Missouri.

APPLICABLE AREA

The species habitat models are applicable to all of Missouri. Counties where the species habitat models were applied for verification purposes include Pike, Lincoln, Livingston, Linn, Lewis, Scotland, Stoddard,and St. Louis.

Wildlife Management Areas (WMAs) where management emphasis is directed at wetland wildlife serve as a standard of comparison for optimum habitat conditions described in the models. These WMAs include Fountain Grove (Linn County), Ted Shanks (Pike County), Marais Temps Clair (St. Charles County) and Duck Creek (Stoddard County).

HABITAT TYPES

Species models are designed to evaluate habitat quality in 4 habitat types:

1. Nonforested Wetland
   This type includes marshes; potholes; sloughs; low, wet grassy areas; and shallow waterlogged depressions. Vegetation can consist of smartweeds, reed canarygrass, sedges, cattails and/or shrubs such as buttonbush or willow. These wetlands may have permanent water lasting all year or semipermanent water lasting a portion of the growing season.

2. Forested Wetland
   Wooded swamps, forested bottomlands (lowland hardwoods) and tree-lined oxbows characterize this type. Dominant trees may include silver maple, elm, sycamore, ash, pin oak, tupelo gum or cypress.

3. Cropland
   This habitat type includes small grain and row crops plus legumes and grass in rotation. Agricultural fields left idle for less than 2 years are still classified as cropfields.

4. Pasture/Hayland
   Included in this category are all pastures and hayfields used for both forage and seed. Typical species include fescue, timothy, red clover, alfalfa and all native grasses. However, fields containing legumes included in the rotation with small grains and row crops are considered in the cropland habitat type.

INSTRUCTIONS AND INFORMATION

Habitat Types and Wildlife Species - Categorize existing vegetation into the habitat types applicable to the species habitat models. Select evaluation wildlife species. Procedures for choosing wildlife species are outlined in the Fish and Wildlife Service Ecological Services Manual (ESM) 102.

Field Sampling - Vegetative data and other information required for the species habitat models can be efficiently collected with the following techniques. These methods were designed for rapid-

the following techniques. These methods were designed for rapidity while at the same time providing a repeatable technique based on recognized sampling procedures. Examples of field sheets to facilitate data collection can be found in the 1983 Handbook for Habitat Evaluation in Missouri.

Forested Wetland - Tree species composition and size class can be determined with a zig-zag transect sampling 20 trees or any other standard forest inventory methods.

Pasture/Hayland - Vegetative characteristics can be measured along a 100 yard transect with sample points spaced every 10 paces or yards. Vegetation is measured by ocular estimate in a triangular plot formed by the pacers feet and a stick placed across the tips of both feet.

Cropland and Nonforested Wetland - Vegetative measurements are not necessary for these habitat types. General information on existing conditions can be determined from direct observation.

Other Measurements and Data Collections - On all habitat types, information on loafing sites, woody invasion, open water, soil texture, etc., can be made by general observation and visual estimate. Photographs available from the Agricultural Stabilization and Conservation Service (ASCS) are suggested for field use. Aerial photographs will facilitate distance measurements between habitat types. All distance measurements should be made from the center of the sample habitat type to the edge of the nearest appropriate habitat type.

HSI Calculations - The habitat type suitability index (HTSI) by species is calculated by totaling the actual scores and dividing that sum by the maximum possible score for that habitat type. Habitat units are the product of the HTSI for an evaluation species times the area of the habitat type. The mean HSI for an evaluation species in its available habitat or within a study area is then calculated by the following procedure:

$$\text{Mean HSI In Available Habitat} = \frac{\Sigma(\text{Habitat Type Suitability Index} \times \text{Habitat Type Acres})}{\text{Total Area of Available Habitat}}$$

Available habitat is defined as the sum of the different habitat type acreages capable of providing support for an evaluation species. For example, available habitat for the mallard consists of the nonforested wetland, forested wetland and cropland habitat types. Available habitat for the least bittern consists of only the nonforested wetland habitat type.

Predicting Future Habitat Quality - The species habitat models in this manual will yield habitat suitability indexes for species by habitat types. The same models that produced baseline HSI values

can be used to calculate future changes in the habitat types' vegetative structure and plant species composition. The first step in predicting future habitat quality with the development of a resource management activity is to display the existing condition field scores for the habitat characteristics by species. Actual score matrixes will display habitat characteristic indexes and point out which habitat characteristics scored low and which scored high. An example of an actual score matrix for the mallard is contained in Appendix A. All habitat characteristics for the mallard in 3 habitat types are listed in abbreviated form on the left side of the matrix. Habitat characteristics are scored on either a 1 to 5 or 1 to 10 scale. The field scores are transferred to the actual score matrix to produce a frequency display by score. Future habitat quality can be predicted by constructing a new actual score matrix for each species, and changing the existing condition scores to form a new frequency score display based on the conditions imposed by the management alternative. New habitat characteristic indexes can be calculated and compared to existing habitat characteristic indexes. A new actual score matrix must be constructed for each management alternative. Finally, revised future HU's can be determined for each proposed action after the area of available habitat is estimated for future years.

Animal Numbers - The 1980 HEP system provides a procedure for determining both the extent of human uses of wildlife and the dollar values of these uses. The FWS Human Use and Economic Evaluation (HUEE) begins with determining the availability or supply of wildlife (U.S. Fish and Wildlife Service, Division of Ecological Services. 1980. Human Use and Economic Evaluation (HUEE). ESM 104. Washington, D.C. 173 pp). Supply or abundance of wildlife depends on habitat quality which is described numerically by the HSI. Animal numbers can be estimated from the HSI and HU by converting a numerical score for habitat quality and quantity into density projections.

An assumption must be made on maximum animal densities associated with an optimum available habitat rating of 1.0. Literature sources and experience on areas of known density can be used to document population densities under best possible conditions. Although the species habitat models are designed for statewide use, estimates of animal abundance under optimum habitat conditions will vary by county or region and cannot be considered uniform throughout the state. Appendix B contains animal densities and HU per animal for optimum habitat as a reasonable estimate for most of Missouri. These figures should be substantiated with more local information if available. Number of HU required per animal and then estimated animal numbers can be calculated according to the following example for the least bittern in a 500 acre nonforested wetland with an average HSI of .58:

Optimum Density with 1.0 Habitat Rating	=	Birds per Habitat unit
1 pair/2 acres		1.0

Available Habitat (Acres)	X	Average HSI for Study Area	=	Total HU for Study Area
500		.58		290

Total Population least bittern:
HU x Birds/HU)
290 X 1.0 = 290 birds

This procedure assumes that the HSI is linearly related to animal numbers. For example, a 50 percent increase in habitat quality (HSI) produces a 50 percent increase in animal numbers.

Life Requisites and Limiting Factors- Species habitat models are designed to consider major life requisites including reproductive sites, food and water sources, and cover (escape, winter and brood rearing). Habitat characteristics describe the plant species composition and structure and other features that will provide these life requisites. Distance between habitat types, as well as plant species composition and structure of adjacent habitat types, are scored to insure that all life requisites are accessible to the evaluation species. Should a life requisite not be accessible to an evaluation species, then that life requisite becomes a limiting factor. Consequently, the evaluation species will either be absent or occur at extremely low and unpredictable densities. Habitat characteristics that are limiting factors are identified in the models. If the habitat characteristic is not present at an identified minimum level, then all other habitat characteristics are disregarded and the habitat type suitability index (HTSI) is entered as 0.1. Some evaluation species have several habitat characteristics that are limiting factors any one of which will result in a 0.1 HTSI. For still other evaluation species, limiting factor calculations are made differently. The HTSI is adjusted by multiplying the initial HTSI by a percentage factor to account for critical limiting factors not present in the available habitat.

ACKNOWLEDGEMENTS

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DEFINITION OF TERMS

AVAILABLE HABITAT - total area that can be expected to provide habitat for the evaluation wildlife species and may be composed of one or more habitat types. Total area of available habitat is the sum of all habitat types likely to be used by the evaluation species in the study (project) area.

CANOPY CLOSURE (TREES) - the degree to which foliage and branches of the forest overstory prevent sunlight from reaching the forest floor. (100% closure = complete canopy, no sunlight on forest floor.)

CHARACTERISTICS (OF HABITAT) - attributes of the habitat that may be critical to the survival, perpetuation, and abundance of an animal species.

COVER - vegetation or other shelter providing protection for wildlife from weather or predators.

DBH - tree diameter at breast height (4.5 ft.)

EDGE - the perimeter of the field, or wetland being evaluated.

EMERGENT VEGETATION - erect, rooted herbaceous plants present for most of the growing season.

EVALUATION ELEMENT - a wildlife species for which habitat quality is evaluated.

FORB - a broad-leaved herbaceous plant.

HABITAT SUITABILITY INDEX - a number representing the comparison between present or projected habitat quality and the optimum conditions possible in the available habitat for a species.

HABITAT TYPE - a kind of environment possessing specific vegetative structural characteristics and plant species composition and categorized in this manual as nonforested wetland, forested wetland, pasture/hayland, and cropland.

HABITAT TYPE SUITABILITY INDEX - a number representing the comparison between present or projected habitat quality and the optimum conditions possible in that habitat type.

HERBACEOUS PLANTS - annual, biennial, or perennial plants whose exposed parts die down at the end of the growing season (forbs, grasses, and grasslike plants).

LEGUME - any plant of the super family Leguminosae (families Papilionacea, Caesalpinaceae, Mimosaceae), and includes alfalfa, red clover, lespedeza and other native or domestic legumes.

OPENING (FOREST) - a space in the forest canopy with less than 10 percent canopy closure.

PERSISTENT EMERGENT VEGETATION - erect, rooted herbaceous vegetation that remains standing during the winter.

SAMPLE UNIT - a circle with 1 mile radius and the center in the field or wetland being evaluated.

SOIL SATURATION - the degree that the soil is water logged.

SUBSTRATE - the base material that lies beneath open water or supports wetland vegetation.

TREE SIZE CLASS - a size category for a forest stand in which 50 percent or more of the trees fall within specific dbh limits.

WATER LEVEL FLUCTUATION - change in water levels either up or down throughout a specified period.

WATER REGIME - the percent of the wetland covered by water throughout a specified period.

MALLARD
(*Anas platyrhynchos*)

Geographic Distribution

Present: Common winter resident statewide but a rare summer resident where wetlands exist.

Historical: Similar to the present distribution but probably more abundant during the summer before most of the state's wetlands were converted to other land uses.

General Habitat

Winter and migratory habitat must emphasize food sources to support large concentrations of mallards for extended periods. Ideal habitat consists of nonforested wetlands with large quantities of annual seed producing plants such as smartweeds and millets associated with forested wetlands dominated by pin oak, willow oak, cherrybark oak or overcup oak. Food sources must not be flooded over 18 inches deep for effective utilization by mallards.

Breeding adults utilize open emergent wetlands for brood rearing. Hens usually nest within 100 yards of water but occasionally nests are located up to 500 yards from water. Preferred nesting habitat consists of grass areas, hayfields, legumes or cereal grains. Mallards will also occasionally nest in cattails and bulrush but generally this species is an upland nester.

Reproduction

Over most of the breeding range nesting occurs between April 15 and April 30. Pair bonding begins as early as November when birds arrive at the wintering areas. Most pair bonds and courtship activities are completed by January or February and pair bonds last until incubation starts. Clutch size varies from 6 to 9 eggs. Each pair defends a territory until incubation begins. The size of this territory depends on the effect of vegetation and topography on site lines. Home ranges can vary from 4 to 20 acres depending on habitat conditions and wetland size. Brood mortality averages 40 percent until the flight stage and birds can generally fly when 52 to 60 days old.

Winter habitat conditions may be an important factor in nesting success. Pairing in southeastern Missouri begins when migrants arrive. Once pairs are formed, molting begins but the female molt can be delayed, interupted, or accelerated depending on environmental and climatic conditions during the winter. Once molting is at or near completion, females deposit large fat and protein reserves before migrating north. These reserves are obtained by intense and segregated feeding bouts by pairs. Early paired females that have completed the molt, migrate first in the spring and use the energy reserves for migration and egg production upon arrival in northern prairie regions. Other females that are younger, lighter, or develop slower do not finish molting on the winter areas and must migrate while still molting.

Food

Winter foods of the mallard consist of corn, smartweeds, wild millet, acorns and rice. Relative proportions depend on the location in the state. Corn and smartweeds account for more than half the diet of migratory birds in northern

Missouri. Rice and acorns are a major portion of the diet in southeastern Missouri. Invertebrates are also important to wintering mallards. Juveniles rely on insects but once fledged, juvenile food habits are very similar to adults.

Important Food Plants

Acorns	Cutgrass	Ragweeds
Agricultural Crops	Duckweeds	Sedges
Beggar Tick	Foxtails	Smartweeds
Bulrush	Japanese Millet	Spikerushes
Chufa	Pigweeds	Wigeon Grass
		Wild Millet

Land Management

Mississippi Flyway mallards winter in the Lower Mississippi Valley from southeastern Missouri to Louisiana although the majority of the birds winter south of Missouri. State lands in the Bootheel still provide winter habitat for significant numbers of mallards. Mallards may also spend much of the winter in more northern portions of Missouri depending on weather conditions, and availability of waste grain and open water. Generally, mallards are best adapted to winter temperatures that average about 32° F. Energetic demands increase rapidly at lower temperatures although males tolerate lower average temperatures better than females.

The decline of natural wetlands along migration corridors has concentrated mallards on fewer stopover and staging areas. Concentrating mallards depletes food sources faster and reduced food supplies increases foraging time. The physiological changes associated with egg laying begins on the wintering grounds. Similarly, wetlands used along migration routes must have the food resources to maintain endogenous proteins and lipids required for egg laying. Therefore, habitat conditions in Missouri from October to March, including the abundance and quality of wetlands, will affect breeding mallard age ratios and nest success.

Habitat utilization by migrating mallards depends on weather, hunting pressure, availability of open water and food supplies. The 4 most important factors influencing food sources are fluctuating water levels, turbidity, water depth and competition by plants that provide little or no food.

As winter habitat, more than 70 percent of the plant coverage in the wetland should be composed of important food plants. Seeds of many native annual wetland plants have as high or higher energy content than row crops although greater production per acre can be achieved with agricultural crops. Food plants should be flooded 1 to 18 inches deep, but mallards show a preference for feeding in water 4 to 6 inches deep. Open water, mudflats or exposed sites for loafing should occur on 10 to 20 percent of the wetland. Shelter from weather is desirable and 5 to 15 percent of the wetland area should be covered by persistent emergents or woody vegetation. Adjacent flooded lowland hardwoods also provide shelter from fall and winter weather.

Mallards will feed in agricultural fields. Flooding will enhance the attractiveness of crop fields to mallards but is not necessary. Corn is the preferred grain crop.

Green tree reservoirs are an important migratory and winter habitat. Flooding of these sites should begin by October 15 and water levels established at 1 inch to 18 inches. Forest management should be directed at encouraging large mast producing trees. Invertebrate populations in lowland hardwoods are also important food source during winter molting and pairing. Duplicating natural flooding patterns will usually stimulate macroinvertebrate numbers. Late spring or summer flooding can result in little or no understory herbaceous vegetation and invertebrates in the fall and winter.

Population Density

Migrant: 10 birds per acre
Resident: 1 pair per 10 acres

Limiting Factor

Migrant: Winter food sources
Resident: Water in wetlands during summer

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Evaluation Element: MALLARD

Habitat Type: NONFORESTED WETLAND
(September 1 - January 1)

CHARACTERISTIC	POSSIBLE SCORE	ACTUAL SCORE
I. Fall and Winter Water Frequency		I.____
1. Water present annually	10	
2. Water present most years with occasional lapse	6- 9	
3. Water present every other year	2- 5	
4. Water present less than every other year; or unpredictable or irregular water; or dry during fall and winter	1	
(NOTE: If characteristic I scores a 1, disregard other criteria and enter .1 as Habitat Type Suitability Index.)		
II. Fall and Winter Flood Conditions (% annual reduction in food plant coverage from siltation and flooding).		II.____
1. Food plant coverage rarely or not affected by fall floods	10	
2. Reduced by less than 25% (multiply HTSI by .75)	8- 9	
3. Reduced by 25 - 50% (multiply HTSI by .50)	5- 7	
4. Reduced by 50 - 75% (multiply HTSI by .25)	2- 4	
5. Reduced by more than 75% (multiply HTSI by .10)	1	
III. Percent Forested and/or Nonforested Wetlands in Sample Unit (2000 Ac.)		III.____
1. More than 75% ($>$1500 Ac.)	10	
2. 50 - 75% (1000 - 1500 Ac.)	8- 9	
3. 25 - 50% (500 -1000 Ac.)	5- 7	
4. 10 - 25% (200 - 500 Ac.)	2- 4	
5. Less than 10% ($<$ 200 Ac.)	1	
(NOTE: If characteristic III scores a 1, disregard other criteria and enter .1 as Habitat Type Suitability Index.)		
IV. Water Depth 1" - 18" Deep (% wetland covered by water September 1 to January 1).		IV.____
1. 50 - 75%	9-10	
2. 75 - 90%	7- 8	
3. Greater than 90%	5- 6	
4. 25 - 50%	3- 4	
5. Less than 25%	1- 2	
V. Important Food Plant Coverage (% wetland covered by seed producing food plants flooded at least 1" deep).		V.____
1. 50 - 75%	9-10	
2. More than 75%	7- 8	
3. 25 - 50% (multiply HTSI by .75)	5- 6	
4. 10 - 25% (multiply HTSI by .50)	3- 4	
5. 1 - 10% (multiply HTSI by .25)	2	
6. Zero (multiply HTSI by .10)	1	
VI. Average Height of Seed Producing Plants Above Water		III.____
1. Less than 2'	5	
2. 2 - 3'	2- 4	
3. More than 3'	1	

Evaluation Element: MALLARD

Habitat Type: NONFORESTED WETLAND
(September 1 - January 1)

CHARACTERISTIC	POSSIBLE SCORE	ACTUAL SCORE
VII. Number of Important Food Plants		VII.____
1. More than 7	5	
2. 4 - 7	2- 4	
3. Less than 4	1	
VIII. Winter Cover (% wetland covered by persistent emergents and/or woody vegetation.		VIII.____
1. 5 - 15%	5	
2. 15 - 25%	3- 4	
3. Less than 5% or 25 - 50%	2	
4. More than 50%	1	
IX. Loafing Sites (% wetland occurring as bare ground, shallow water areas <1" deep, mounds, mudflats, etc.).		IX.____
1. 5 - 10% scattered throughout wetland	5	
2. 10 - 20% scattered throughout wetland	3- 4	
3. Mainly along periphery of wetland	2	
4. Less than 5% or more than 20%	1	
X. Open Water (% wetland occurring as open water without persistent emergent woody or annual vegetation).		X.____
1. 5 - 10%	5	
2. Less than 5%	3- 4	
3. 10 - 25%	2	
4. Greater than 25%	1	
XI. Distance to Forested Wetland (bottomland hardwoods).		XI.____
1. Adjacent flooded annually	10	
2. Less than 4 miles flooded annually	8- 9	
3. Adjacent flooded at least every other year	5- 7	
4. Less than 4 miles flooded at least every other year	2- 4	
5. Greater than 4 miles to any forested wetland; or less than 4 miles with flooding unpredictable; or no fall or winter flooding	1	
XII. Distance to Cropland		XII.____
1. Adjacent unharvested or partially unharvested and flooded annually	10	
2. Less than 4 miles unharvested or partially unharvested and flooded annually	8- 9	
3. Adjacent unharvested or partially unharvested and flooded at least every other year; or adjacent unflooded with residues undisturbed	5- 7	
4. Less than 4 miles unharvested or partially unharvested and flooded at least every other year; or less than 4 miles unflooded with residues undisturbed; or winter wheat	2- 4	
5. Greater than 4 miles to any cropfield; or less than 4 miles to unflooded cropfield with residues disced or plowed	1	

$$\frac{\text{Total Actual Score}}{\text{Maximum Potential Score (95)}} = \text{Habitat Type Suitability Index}$$

(NOTE: Multiply HTSI by appropriate percentages indicated in parenthesis for characteristics II and V. Enter this figure or .1, whichever is greater as final HTSI.)

Evaluation Element: MALLARD

Habitat Type: FORESTED WETLAND
(September 1 - January 1)

CHARACTERISTIC	POSSIBLE SCORE	ACTUAL SCORE
I. Fall and Winter Water Frequency		I._____
1. Water present annually	10	
2. Water present most years with occasional lapse	6- 9	
3. Water present every other year	2- 5	
4. Water present less than every other year; or unpredictable or irregular water; or dry during fall and winter	1	
(NOTE: If characteristic I scores a 1, disregard other criteria and enter .1 as Habitat Type Suitability Index.)		
II. Fall and Winter Flood Conditions (% annual reduction in food plant coverage from siltation and flooding).		II._____
1. Food plant coverage rarely or not affected by fall floods	10	
2. Reduced by less than 25% (multiply HTSI by .75)	8- 9	
3. Reduced by 25 - 50% (multiply HTSI by .50)	5- 7	
4. Reduced by 50 - 75% (multiply HTSI by .25)	2- 1	
5. Reduced by more than 75% (multiply HTSI by .10)	1	
III. Percent Forested and/or Nonforested Wetlands in Sample Unit (2000 Ac.)		III._____
1. More than 75% (> 1500 Ac.)	10	
2. 50 - 75% (1000 - 1500 Ac.)	8- 9	
3. 25 - 50% (500 - 1000 Ac.)	5- 7	
4. 10 - 25% (200 - 500 Ac.)	2- 4	
5. Less than 10% (< 200 Ac.)	1	
(NOTE: If characteristic III scores a 1, disregard other criteria and enter .1 as Habitat Type Suitability Index.)		
IV. Water Depth 1" - 18" Deep (% forested wetland covered by water September 1 - January 1).		IV._____
1. 50 - 75%	9-10	
2. 75 - 90%	7- 8	
3. Greater than 90%	5- 6	
4. 25 - 50%	3- 4	
5. Less than 25%	1- 2	
V. Important Food Plant Coverage (% wetland covered by seed producing food plants flooded at least 1" deep).		V._____
1. 50 - 75%	9-10	
2. More than 75%	7- 8	
3. 25 - 50% (multiply HTSI by .75)	5- 6	
4. 10 - 25% (multiply HTSI by .50)	3- 4	
5. 1 - 10% (multiply HTSI by .25)	2	
6. Zero (multiply HTSI by .10)	1	
VI. Number of Important Food Plants		VI._____
1. More than 7	5	
2. 4 - 7	2- 4	
3. Less than 7	1	

Evaluation Element: MALLARD

Habitat Type: FORESTED WETLAND
(September 1 - January 1)

CHARACTERISTIC	POSSIBLE SCORE	ACTUAL SCORE
VII. Tree Size Class and Canopy Closure		VII.____

Canopy Closure	Code Size Class (dbh) of Trees Composing Predominant Foliage Layer (Overstory)
1=70-100%	S = sawtimber (more than 9")
2=40-69%	P = poles/small trees (2 - 9")
3=10-39%	R = reproduction (less than 2")

No Size Class Predominant in Overstory
M= Mixed (must include sawtimber component)

1.	2,3-S or 2,3-M	9-10
2.	1-S or 1-M	7- 8
3.	1,2,3-P with scattered sawtimber present	5- 6
4.	1,2,3-P without scattered sawtimber; or 1,2,3-R with scattered sawtimber present	3- 4
5.	1,2,3-R without scattered sawtimber	1- 2

VIII.	Forest Overstory Composition		VIII.____
1.	More than 50% of trees as oaks	8-10	
2.	20 - 50% of trees as oaks	5- 7	
3.	Less than 20% of trees as oaks	2- 4	
4.	No oaks	1	
IX.	Permanent Water Within Stand (% of stand covered by oxbows, old channels, vernal ponds, or shallow depressions).		IX.____
1.	10 - 25%	4- 5	
2.	5 - 10% or 25 - 50%	2- 3	
3.	Less than 5% or more than 50%	1	
X.	Openings (% of stand with less than 10% canopy closure).		X.____
1.	15 - 30%	4- 5	
2.	5 - 15% or 30 - 45%	2- 3	
3.	Less than 5% or more than 45%	1	
XI.	Distance to Nonforested Wetland		XI.____
1.	Adjacent flooded annually	10	
2.	Less than 4 miles flooded annually	8- 9	
3.	Adjacent flooded at least every other year	5- 7	
4.	Less than 4 miles flooded at least every other year	2- 4	
5.	Greater than 4 miles to any nonforested land; or less than 4 miles with flooding unpredictable; or no fall or winter flooding	1	

Evaluation Element: MALLARD

Habitat Type: FORESTED WETLAND
(September 1 - January 1)

CHARACTERISTIC	POSSIBLE SCORE	ACTUAL SCORE
XII. Distance to Cropland		XII._____
1. Adjacent unharvested or partially unharvested and flooded annually	9-10	
2. Less than 4 miles unharvested or partially unharvested and flooded annually	7- 8	
3. Adjacent unharvested or partially unharvested and flooded at least every other year; or adjacent unflooded with residues undisturbed	5- 6	
4. Less than 4 miles unharvested or partially unharvested and flooded at least every other year; or less than 4 miles unflooded with residues undisturbed; or winter wheat	3- 4	
5. Greater than 4 miles to any cropfield; or less than 4 miles to unflooded cropfield with residues chiseled, disced or plowed	1- 2	

$$\frac{\text{Total Actual Score}}{\text{Maximum Potential Score (105)}} = \text{Habitat Type Suitability Index}$$

(NOTE: Multiply HTSI by appropriate percentages indicated in parenthesis for characteristics II and V. Enter this figure or .1, whichever is greater as final HTSI.)

Evaluation Element: MALLARD

Habitat Type: CROPLAND
(September 1 - January 1)

CHARACTERISTIC	POSSIBLE SCORE	ACTUAL SCORE
I. Fall and Winter Water Frequency		I._____
1. Water present annually	10	
2. Water present most years with occasional lapse	6- 9	
3. Water present every other year	2- 5	
4. Water present less than every other year; or unpredictable or irregular water; or dry during fall and winter	1	
(NOTE: If characteristic I scores a 1, disregard other criteria and enter .1 as Habitat Type Suitability Index.)		
II. Percent Forested and/or Nonforested Wetlands in Sample Unit (2000 Ac.)		II._____
1. More than 75% (>1500 Ac.)	10	
2. 50 - 75% (1000 - 1500 Ac.)	8- 9	
3. 25 - 50% (500 - 1000 Ac.)	5- 7	
4. 10 - 25% (200 - 500 Ac.)	2- 4	
5. Less than 10% (<200 Ac.)	1	
(NOTE: If characteristic II scores a 1, disregard other criteria and enter .1 as Habitat Type Suitability Index.)		
III. Water Depth 1" - 18" Deep (% cropfield covered by water September to January 1)		III._____
1. 50 - 75%	9-10	
2. 75 - 90%	7- 8	
3. Greater than 90%	5- 6	
4. 25 - 50%	3- 4	
5. Less than 25%	1- 2	
IV. Land Management		IV._____
1. No fall plowing or discing, residues undisturbed	9-10	
2. Chisel plowing once in fall	7- 8	
3. Crop residues grazed, chopped or baled	5- 6	
4. Fall discing or winter wheat	3- 4	
5. Fall moldboard plowing	1- 2	
V. Cropping Practices		V._____
1. More than 25% unharvested grain over winter	9-10	
2. 10 - 25% unharvested grain over winter	7- 8	
3. Less than 10% unharvested grain over winter	5- 6	
4. Completely harvested with little herbicide	3- 4	
5. Completely harvested with heavy herbicide	1- 2	
VI. Distance to Forested Wetland (bottomland hardwoods)		VI._____
1. Adjacent flooded annually	10	
2. Less than 4 miles flooded annually	8- 9	
3. Adjacent flooded at least every other year	5- 7	
4. Less than 4 miles flooded at least every other year	2- 4	
5. Greater than 4 miles to any forested wetland; or less than 4 miles with flooding unpredictable; or no fall or winter flooding	1	

Evaluation Element: MALLARD

Habitat Type: CROPLAND
(September 1 - January 1)

CHARACTERISTIC	POSSIBLE SCORE	ACTUAL SCORE
VII. Distance to Nonforested Wetland		VII.____
1. Adjacent flooded annually	10	
2. Less than 4 miles flooded annually	8- 9	
3. Adjacent flooded at least every other year	5- 7	
4. Less than 4 miles flooded at least every other year	2- 4	
5. Greater than 4 miles to any nonforested wetland; or less than 4 miles flooding unpredictable; or no fall or winter flooding	1	

$$\frac{\text{Total Actual Score}}{\text{Maximum Possible Score (70)}} = \text{Habitat Type Suitability Index}$$

CANADA GOOSE
(*Branta canadensis*)

Geographic Distribution

Present: Resident geese are known to nest in 52 Missouri counties. The Department has a Canada goose restoration program to stock resident geese in suitable habitat. Migrant geese occur statewide but are generally confined to traditional wintering areas on state wildlife areas, national wildlife refuges or Corps of Engineers' reservoirs.

Historical: The resident Canada goose was probably confined to the vicinity of the state's major rivers and their flood plains and this subspecies was believed extirpated by 1900. The Missouri Canada goose restoration program began at Trimble Wildlife Area in 1952.

General Habitat

Missouri has both resident and migratory populations of Canada geese. Migrating geese require abundant food sources, open water and protection from hunting. Canada geese are adaptable, feeding in agricultural fields (row crop, small grain or grass/legume), or nonforested wetlands. Geese prefer large, open fields for feeding in agricultural areas, but roosting habitat consists of wetlands interspersed with open water. Lake shores with gently sloping banks and short (less than 6 inches) vegetation are attractive loafing areas.

Resident geese locate nests near open water with broad visibility. Lakes, ponds, oxbows or marshes are suitable if adjacent land use permits good visibility and access to upland food sources including grasses or legumes.

Reproduction

Territory selection for resident geese in Missouri begins in February. The nesting territory is selected by the female and defended by the male. Nesting begins in mid-March but can be delayed to mid-April by weather conditions. Peak incubation occurs at the end of March. Incubation lasts 28 days and clutches average 5 to 6 eggs.

Hatching occurs from mid-April to early May with broods maintaining an identity for about one week. Gosling mortality is usually more than 30 percent with 90 percent of this mortality occurring in the first 2 weeks. Gang broods may form 1 week after hatching with several adult pairs tending the young. Younger females are more likely to loose their young to gang broods than older females. In Missouri, approximately 60 percent of the 2 year old males mate while only 40 to 50 percent of 2 year old females will breed.

Territory size is related to habitat conditions such as the location of the male's loafing site to the nest and visibility from the nest site. Territories are usually larger than 2 acres with home ranges 1.5 to 2 square miles.

Nest substrates are variable but a firm base close to water is necessary. Geese will nest up to 280 feet from water but closer is preferable. Ground nests may be located on islands or along shorelines. Predation is high with ground nests and these nests are also susceptible to flooding. Geese will also nest in trees or

ledges 5 to 50 feet high. Nest structures can significantly improve nest success. Structures can be placed along pond banks, lake shores, river banks or marshes. Ponds should be greater than 1 acre to accommodate a nest structure.

Food

In Missouri, the principal winter foods are wheat, corn, milo, smartweed, wild millet, umbrella sedge, spike rush, soybeans, ragweeds, legumes and cool-season grasses. There are seasonal differences in food preferences that reflect availability and energy demands of geese. Soybeans may cause crop impaction. Wintering geese can consume 1/2 pound of grain per goose each day. Food intake is also related to air temperatures. An adequate food supply during the winter and migration periods are critical to breeding success.

Goose breeding sites should provide aquatic habitats for brood food sources and grass/legume areas for adults and broods to feed after the young are fledged. Goslings begin to feed on the shoots of grasses and forbs soon after hatching. Resident geese browse on grasses and legumes for most of the year switching to cereal grains in cold weather.

Important Food Plants

Acorns	Clovers	Pondweeds
Agricultural Crops	Coontail	Ragweeds
Alfalfa	Cutgrass	Sedges
Beggar Tick	Foxtails	Smartweeds
Bluegrass	German Millet	Spikerushes
Bulrush	Japanese Millet	Wild Millet
Chufa	Pigweeds	

Land Management

Canada geese have a strong tendency to particular breeding and wintering areas as well as migration corridors, resulting in distinct populations. Wintering populations tend to be cohesive. There are 2 specific populations wintering in Missouri. (1) The Eastern Prairie Population's (EPP) major wintering area is Swan Lake National Wildlife Refuge. These birds breed on Hudson Bay north of Churchill. Most of this population is composed of the interior race. (2) The Mississippi Valley Population (MVP) is composed of interior race birds that breed south of Hudson Bay and winter at Horseshoe Lake National Wildlife Refuge in Illinois. MVP geese wintered along the Mississippi River between Cape Girardeau and the Gulf of Mexico before the establishment of this refuge. Most birds are now found in the vicinity of Horseshoe Lake, Illinois.

Management of migratory geese must emphasize food sources and open water. Canada geese winter at traditional sites but will range widely in search of food. In Missouri, a management objective at established Canada geese wintering areas on public lands is to provide 50 percent of the food requirements for wintering geese. One bushel of corn or equivalent will feed 120 geese for one day. Adequate food sources will restrict dispersal during the hunting season and reduce crop depredation on private land and allow time for adjacent landowners to harvest crops.

Wintering Canada geese will feed in cropfields or grasslands. Cropfields should be large (20 to 40 acres) because geese prefer open fields. Vegetation along the edges of fields less than 40 acres in size should be less than 10 feet tall to

give the field a more open appearance to geese. Fields with standing crops are more attractive to geese with 10 to 30 foot wide mowed strips that allow geese to land in short vegetation. Cropfields do not need to be flooded.

Green browse for geese can be provided with winter wheat, legumes (such as red clover) or grass areas preferably bluegrass. Field size should also be 20 to 40 acres. Borders around smaller fields should have vegetation less than 10 feet tall. Vegetation in grass areas should be less than 6 inches tall. Winter wheat can be seeded up to twice the normal rate to provide fall and early winter browse when the production of a summer wheat crop is not essential.

Open water during the winter is also important to Canada geese. Large numbers of geese can usually maintain some open water in impoundments during cold weather. Adjacent or nearby rivers will provide open water but suitable loafing sites such as sandbars or gently sloping banks are necessary. Loafing sites should have good visibility.

The structure and plant species composition of wetlands attractive to Canada geese are similar to the mallard. Management of resident geese must emphasize nesting and brood rearing sites. Nest sites must have good visibility and a sound nest base that is not susceptible to flooding. Artificial nest structures are important but geese will use muskrat houses, beaver lodges, bales of straw or floating platforms. Ideal brood rearing areas consist of wetlands with island complexes, small ponds or lakes with emergent vegetation or oxbows and backwater areas with emergent vegetation. Within a week after hatching, gosling food habits become similar to adults and grasses, legumes, agricultural crops and emergent vegetation become the dominant food items.

The northward migration of wintering geese may occur over a 2 to 3 month period beginning in February. The fall migration to Missouri is more of a cohesive movement with birds arriving in October. Resident geese usually do not migrate in the fall if food and open water are available. However, a molt migration for many nonbreeding birds occurs in May. Resident geese from Missouri have been located in Ontario during the summer and these birds generally return to Missouri in September.

Resident geese can be restored to suitable habitat. Potential sites should have a good distribution of small ponds, lakes or impoundments consisting of 15 or more water bodies per 1,000 to 2,000 acre management units. Groups of 3 impoundments spaced at 1/8 to 1/4 mile intervals will provide optimum habitat. Most impoundments should be less than 20 acres in size but one impoundment greater than 40 acres is desirable. Most impoundments should have grass borders and cropland, grassland or wetland should be the predominate land uses in the vicinity. A major river (greater than 100 feet wide) or a lake or reservoir greater than 100 acres should be within 4 miles. Finally, an established Canada goose wintering area open to hunting should not be within 10 miles to prevent birds from moving to wintering areas where hunting mortality may be great.

Population Density

Resident: 1 pair per 10 acres
Migrant: 4 geese per acre

Limiting Factors

Resident: Nesting sites
Wetlands with water during summer

Migrant: Winter food sources

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Evaluation Element: CANADA GOOSE

Habitat Type: NONFORESTED WETLANDS
(September 1 - January 1)

CHARACTERISTIC	POSSIBLE SCORE	ACTUAL SCORE
I. Fall and Winter Water Frequency		I.____
1. Water present annually	10	
2. Water present most years with occasional lapse	6- 9	
3. Water present every other year	2- 5	
4. Water present less than every other year; or unpredictable or irregular water; or dry during fall and winter	1	
(NOTE: If characteristic I scores a 1, disregard other criteria and enter .1 as Habitat Type Suitability Index.)		
II. Fall and Winter Flood Conditions (% annual reduction in food plant coverage from siltation and flooding).		II.____
1. Food plant coverage rarely or not affected by fall floods	10	
2. Reduced by less than 25% (multiply HTSI by .75)	8- 9	
3. Reduced by 25 - 50% (multiply HTSI by .50)	5- 7	
4. Reduced by 50 - 75% (multiply HTSI by .25)	2- 4	
5. Reduced by more than 75% (multiply HTSI by .10)	1	
III. Percent Nonforested Wetlands and/or Open Water in Sample Unit (2000 Ac.)		III.____
1. More than 75% (>1500 Ac.)	10	
2. 50 - 75% (1000 - 1500 Ac.)	8- 9	
3. 25 - 50% (500 - 1000 Ac.)	5- 7	
4. 10 - 25% (200 - 500 Ac.)	2- 4	
5. Less than 10% (<200 Ac.)	1	
(NOTE: If characteristic III scores 1, disregard other criteria and enter .1 as Habitat Type Suitability Index.)		
IV. Water Depth 1" - 18" Deep (% wetland covered by water September 1 to January 1.)		IV.____
1. 50 - 75%	9-10	
2. 75 - 90%	7- 8	
3. Greater than 90%	5- 6	
4. 25 - 50%	3- 4	
5. Less than 25%	1- 2	
V. Important Food Plant Coverage (% wetland covered by seed producing food plants flooded at least 1" deep).		V.____
1. 50 - 75%	9-10	
2. More than 75%	7- 8	
3. 25 - 50% (multiply HTSI by .75)	5- 6	
4. 10 - 25% (multiply HTSI by .50)	3- 4	
5. 1 - 10% (multiply HTSI by .25)	2	
6. Zero (multiply HTSI by .10)	1	
VI. Average Height of Seed Producing Plants Above Water		VI.____
1. Less than 2'	5	
2. 2 - 3'	2- 4	
3. More than 3'	1	

Evaluation Element: CANADA GOOSE

Habitat Type: NONFORESTED WETLANDS
(September 1 - January 1)

CHARACTERISTIC	POSSIBLE SCORE	ACTUAL SCORE
VII. Number of Important Food Plants		VII.____
1. More than 7	5	
2. 4 - 7	2- 4	
3. Less than 4	1	
VIII. Winter Cover (% wetland covered by persistent emergents and/or woody vegetation).		VIII.____
1. 5 - 15%	5	
2. 15 - 25%	3- 4	
3. Less than 5% or 25 - 50%	2	
4. More than 50%	1	
IX. Loafing Sites (% wetland occurring as bare ground, shallow water areas <1" deep, mounds, mudflats, etc.).		IX.____
1. 5 - 10% scattered throughout wetland	5	
2. 10 - 20% scattered throughout wetland	3- 4	
3. Mainly along periphery of wetland	3	
4. Less than 5% or more than 20%	1	
X. Open Water (% wetland occurring as open water without persistent emergent, woody or annual vegetation).		X.____
1. 5 - 10%	5	
2. Less than 5%	3- 4	
3. 10 - 25%	2	
4. Greater than 25%	1	
XI. Distance to Pasture/Hayland		XI.____
1. Adjacent with winter height less than 6" and field size more than 40 acres	8-10	
2. Less than 4 miles with winter height less than 6" and field size more than 40 acres	5- 7	
3. Less than 4 miles with winter height less than 6" and field size 10 - 40 acres	2- 4	
4. More than 4 miles to any pasture/hayland; or less than 4 miles to pasture/hayland with winter height more than 6"; or less than 4 miles to pasture/hayland less than 10 acres.	1	
XII. Distance to Cropland		XII.____
1. Adjacent not fall plowed, chiseled, or disced; or winter wheat present	9-10	
2. Less than 4 miles not fall plowed, chiseled, or disced; or winter wheat present	7- 8	
3. Adjacent with residues chiseled, disced, chopped, baled or grazed	5- 6	
4. Less than 4 miles with residues chiseled, disced, chopped, baled or grazed	3- 4	
5. More than 4 miles to any cropfield; or less than 4 miles to cropfield fall plowed	1- 2	
XIII. Distance to Major River, Lake or Reservoir >100 Acres		XIII.____
1. Less than 4 miles	8-10	
2. 4 - 10 miles	5- 7	
3. 10 - 25 miles	2- 4	
4. More than 25 miles	1	

Evaluation Element: CANADA GOOSE

Habitat Type: NONFORESTED WETLANDS
(September 1 - January 1)

CHARACTERISTIC	POSSIBLE SCORE	ACTUAL SCORE
XIV. Distance to Major Canada Goose Winter Area		IVX._____
1. Less than 4 miles	8-10	
2. 4 - 10 miles (multiply HTSI by .75)	5- 7	
3. 10 - 25 miles (multiply HTSI by .50)	2- 4	
4. More than 25 miles (multiply HTSI by .25)	1	

$$\frac{\text{Total Actual Score}}{\text{Maximum Potential Score (115)}} = \text{Habitat Type Suitability Index}$$

(NOTE: Multiply HTSI by appropriate percentages in parenthesis for characteristic II, VI and XIV. Enter this figure or .1, whichever is greater as final HTSI.)

Major rivers are defined as watercourses greater than 100 feet wide and may include the following: Missouri, Mississippi, Grand, Osage, Chariton, St. Francois and Black. All Corps of Engineers' impoundments will qualify as major reservoirs. Distances can be estimated from county or state road maps.

Major wintering areas include only the following state wildlife management areas (WMA) and national wildlife refuges (NWR) and Corps of Engineers Reservoirs: Fountain Grove WMA (Linn County), Swan Lake NWR (Chariton County), Smithville Reservoir (Clay County), Thomas Hill WMA (Randolph County), Clarence Cannon Reservoir (Audrain County), Schell-Osage WMA (St. Clair County), Table Rock Reservoir (Stone County), Bull Shoals Reservoir (Taney County), Duck Creek WMA (Stoddard County), Mingo NWR (Stoddard County), Stockton Reservoir (Cedar County) and August Busch WMA (St. Charles County).

Evaluation Element: CANADA GOOSE

Habitat Types: CROPLAND
(September 1 - January 1)

CHARACTERISTICS	POSSIBLE SCORE	ACTUAL SCORE
VIII. Distance to Nonforested Wetland		VIII.____
1. Adjacent flooded annually	10	
2. Less than 4 miles flooded annually	8- 9	
3. Adjacent flooded at least every other year	5- 7	
4. Less than 4 miles flooded at least every other year	2- 4	
5. Greater than 4 miles to any nonforested wetland; or less than 4 miles with flooding unpredictable; or no fall or winter flooding	1	
IX. Distance to Pasture/Hayland		IX.____
1. Adjacent with winter height less than 6" and field size more than 40 acres	8-10	
2. Less than 4 miles with winter height less than 6" and field size more than 40 acres	5- 7	
3. Less than 4 miles with winter height less than 6" and field size 10 - 40 acres	2- 4	
4. More than 4 miles to any pasture/hayland or less than 4 miles to pasture/hayland with winter height more than 6"; or less than 4 miles to pasture/hayland less than 10 acres	1	
X. Distance to Major River, Lake or Reservoir >100 Acres		X.____
1. Less than 4 miles	8-10	
2. 4 - 10 miles	5- 7	
3. 10 - 25 miles	2- 4	
4. More than 25 miles	1	
XI. Distance to Major Canada Goose Winter Area		XI.____
1. Less than 4 miles	8-10	
2. 4 - 10 miles (multiply HTSI by .75)	5- 7	
3. 10 - 25 miles (multiply HTSI by .50)	2- 4	
4. More than 25 miles (multiply HTSI by .25)	1	

$$\frac{\text{Total Actual Score}}{\text{Maximum Potential Score (100)}} = \text{Habitat Type Suitability Index}$$

(NOTE: Multiply HTSI by appropriate percentages in parenthesis for characteristic XI. Enter this figure or .1, whichever is greater as final HTSI.)

Major rivers are defined as watercourses greater than 100 feet wide and may include the following: Missouri, Mississippi, Grand, Osage, Chariton, St. Francois and Black. All Corps of Engineers' impoundments will qualify as major reservoirs. Distances can be estimated from county or state road maps.

Major wintering areas include only the following state wildlife management areas (WMA) and national wildlife refuges (NWR) and Corps of Engineers Reservoirs: Fountain Grove WMA (Linn County), Swan Lake NWR (Chariton County), Smithville Reservoir (Clay County), Thomas Hill WMA (Randolph County), Clarence Cannon Reservoir (Audrain County), Schell-Osage WMA (St. Clair County), Table Rock Reservoir (Stone County), Bull Shoals Reservoir (Taney County), Duck Creek WMA (Stoddard County), Mingo NWR (Stoddard County), Stockton Reservoir (Cedar County) and August Busch WMA (St. Charles County).

Evaluation Element: CANADA GOOSE

Habitat Type: CROPLAND
(September 1 - January 1)

CHARACTERISTIC	POSSIBLE SCORE	ACTUAL SCORE
I. Fall and Winter Water Frequency		I.____
1. Water present annually	10	
2. Water present most years with occasional lapse	6- 9	
3. Water present every other year	2- 5	
4. Water present less than every other year; or unpredictable or irregular water; or dry during fall and winter	1	
II. Percent Nonforested Wetlands and/or Open Water in Sample Unit (2000 Ac.)		II.____
1. More than 75% (>1500 Ac.)	10	
2. 50 - 75% (1000 - 1500 Ac.)	8- 9	
3. 25 - 50% (500 - 1000 Ac.)	5- 7	
4. 10 - 25% (200 - 500 Ac.)	2- 4	
5. Less than 10% (< 200 Ac.)	1	
(NOTE: If characteristic II scores a 1, disregard other criteria and enter .1 as Habitat Type Suitability Index.)		
III. Water Depth 1" - 18" Deep (% cropfield covered by water September 1 to January 1)		III.____
1. 25 - 75%	4- 5	
2. More than 75%	2- 3	
3. Less than 25%	1	
IV. Crop Rotation		IV.____
1. Row crops - small grains - legume	4- 5	
2. Row crops - small grains	2- 3	
3. Continuous row crops or small grains	1	
V. Land Management		V.____
1. No fall plowing or discing, residues undisturbed; or winter wheat	9-10	
2. Chisel plowing once in fall	7- 8	
3. Crop residues grazed, chopped or baled	5- 6	
4. Fall discing	3- 4	
5. Fall moldboard plowing	1- 2	
VI. Cropping Practices		VI.____
1. 10 - 25% unharvested grain over winter	8-10	
2. More than 25% unharvested grain over winter	6- 7	
3. Less than 10% unharvested grain over winter	4- 5	
4. Completely harvested with little herbicide	2- 3	
5. Completely harvested with heavy herbicide	1	
VII. Field Size (% of field within 660 feet of forest, woodlot, treeline or shelterbelt).		VII.____
1. Less than 25%	8-10	
2. 25 - 50%	4- 7	
3. 50 - 75%	2- 3	
4. More than 75%	1	

Evaluation Element: CANADA GOOSE

Habitat Type: PASTURE & HAYLAND
(September 1 - January 1)

CHARACTERISTIC	POSSIBLE SCORE	ACTUAL SCORE
I. Percent Nonforested Wetlands and/or Open Water in Sample Unit (2000 Ac.)		I.____
1. More than 75% (>1500 Ac.)	10	
2. 50 - 75% (1000 - 1500 Ac.)	8- 9	
3. 25 - 50% (500 - 1000 Ac.)	5- 7	
4. 10 - 25% (200 - 500 Ac.)	2- 4	
5. Less than 10% (<200 Ac.)	1	
(NOTE: If characteristic I scores a 1, disregard other criteria and enter .1 as Habitat Type Suitability Index.)		
II. Grass area composition		II.____
1. Bluegrass monotype, clover or alfalfa; or mixed cool season grasses with legumes	9-10	
2. Mixed cool season grasses	7- 8	
3. Timothy or orchardgrass	4- 6	
4. Fescue monotype	2- 3	
5. Warm season grasses	1	
III. Average Height of Herbaceous Vegetation (September 1 - January 1).		III.____
1. Less than 6"	10	
2. More than 6"	1	
IV. Field Size (% field within 660 feet of forest, woodlot, treeline or shelterbelt).		IV.____
1. Less than 25%	8-10	
2. 25 - 50%	4- 7	
3. 50 - 75%	2- 3	
4. More than 75%	1	
V. Distance to Nonforested Wetland		V.____
1. Adjacent flooded annually	10	
2. Less than 4 miles flooded annually	8- 9	
3. Adjacent flooded at least every other year		
4. Less than 4 miles flooded at least every other year	2- 4	
5. Greater than 4 miles to any nonforested wetland; or less than 4 miles flooding unpredictable; or no fall or winter flooding	1	
VI. Distance to Cropland		VI.____
1. Adjacent not fall plowed, chiseled, or disced; or winter wheat present	9-10	
2. Less than 4 miles not fall plowed, chiseled, or disced; or winter wheat present	7- 8	
3. Adjacent with residues chiseled, disced, chopped, baled or grazed	5- 6	
4. Less than 4 miles with residues chiseled, disced, chopped, baled or grazed	3- 4	
5. More than 4 miles to any cropfield; or less than 4 miles to cropfield fall plowed	1- 2	

Evaluation Element: CANADA GOOSE

Habitat Type: PASTURE & HAYLAND
(September 1 - January 1)

CHARACTERISTIC	POSSIBLE SCORE	ACTUAL SCORE
VII. Distance to Major River, Lake or Reservoir >100 Acres		VII.____
1. Less than 4 miles	8-10	
2. 4 - 10 miles	5- 7	
3. 10 - 25 miles	2- 4	
4. More than 25 miles	1	
VIII. Distance to Major Canada Goose Winter Area		VIII.____
1. Less than 4 miles	8-10	
2. 4 - 10 miles (multiply HTSI by .75)	5- 7	
3. 10 - 25 miles (multiply HTSI by .50)	2- 4	
4. More than 25 miles (multiply HTSI by .25)	1	

$$\frac{\text{Total Actual Score}}{\text{Maximum Potential Score (80)}} = \text{Habitat Type Suitability Index}$$

(NOTE: Multiply HTSI by appropriate percentages in parenthesis for characteristic VIII. Enter this figure or .1, whichever is greater as final HTSI.)

Major rivers are defined as watercourses greater than 100 feet wide and may include the following: Missouri, Mississippi, Grand, Osage, Chariton, St. Francois and Black. All Corps of Engineers' impoundments will qualify as major reservoirs. Distances can be estimated from county or state road maps.

Major wintering areas include only the following state wildlife management areas (WMA) and national wildlife refuges (NWR) and Corps of Engineers Reservoirs: Fountain Grove WMA (Linn County), Swan Lake NWR (Chariton County), Smithville Reservoir (Clay County), Thomas Hill WMA (Randolph County), Clarence Cannon Reservoir (Audrain County), Schell-Osage WMA (St. Clair County), Table Rock Reservoir (Stone County), Bull Shoals Reservoir (Taney County), Duck Creek WMA (Stoddard County), Mingo NWR (Stoddard County), Stockton Reservoir (Cedar County) and August Busch WMA (St. Charles County).

Least Bittern
(Ixobrychus exilis)

Geographic Distribution

Present: Uncommon summer resident in north, west central and southeastern Missouri.

Historical: Historical distribution was probably similar to the present distribution but habitat destruction has restricted breeding opportunities in Missouri.

General Habitat

Least bitterns are found in wetlands dominated by dense emergent vegetation. These birds prefer glacial type marshes with vegetation interspersed with open water. River bulrush and smartweed growing in 1 to 3 feet of water are the preferred nesting substrate. The least bittern is a very secretive bird whose presence can easily go undetected. This bird is classified as rare by the Missouri Department of Conservation.

Reproduction

Migration dates are not well known in Missouri, but most adults probably arrive in late April and leave between late August and October. In Illinois, peak egg laying is in June. Nests are constructed in dense vegetation 6 to 24 inches above water. Preferred nesting substrate is river bulrush and smartweeds but sawgrass, cattail and burreed are also used. Occasionally, nests are constructed on old abandoned nests of other birds. Incubation lasts 17 to 20 days and clutch size is usually 2 to 5 eggs. Young birds will leave the nest for short periods as early as 6 to 9 days after hatching. The male is territorial but territory size is unkown for Missouri. Active nests can be spaced as close as 5 to 6 yards.

Food

Least bitterns are omnivorous eating fish, tadpoles, small frogs, insects and snails. Where the water is too deep to wade, this bird walks through the vegetation by clasping upright stems. The least bittern can compress its body to facilitate passage through dense vegetation or hide from enemies.

Land Management

Least bittern numbers are subject to annual fluctuations depending on local water conditions. Standing water and emergent vegetation are essential for least bittern habitat. Bitterns require fairly dense marshes. Open water without emergent vegetation is not necessary. Water levels can fluctuate as long as shallow water is available for wading and foraging. Water depths of 1 to 18 inches facilitates wading and foraging. Least bitterns are not attracted to marshes with woody invasion. Wetland size is important for maintaining viable populations. Marshes less than 20 acres are undesirable but wetland complexes totaling more than 1,500 acres with several marshes in different successional stages will attract optimum numbers of least bitterns.

Population Density

1 pair per 2 acres

Limiting Factor

Emergent vegetation
Water present during summer

References

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KUSHLAN, J.A. 1976. Feeding behavior of North American herons. Auk 93:86-94.

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Evaluation Element: LEAST BITTERN — Habitat Type: NONFORESTED WETLAND

CHARACTERISTIC	POSSIBLE SCORE	ACTUAL SCORE
I. Emergent Vegetation Coverage (% wetland covered by cattails, bulrush, burreed and smartweeds)		I.___
1 75 - 90%	10	
2. 50 - 75%	7- 9	
3. More than 90%	4- 6	
4. 25 - 50%	2- 3	
5. Less than 25%	1	
II. Wetland Size (Acres)		II.___
1. More than 100 acres	5	
2. 75 - 100 acres	4	
3. 50 - 75 acres	3	
4. 20 - 50 acres	2	
5. Less than 20 acres	1	
(NOTE: If characteristics I and II score a 1, disregard other criteria and enter .1 as Habitat Type Suitability Index)		
III. Water Regime (% wetland covered by permanent water April 15 - August 1, average conditions)		III.___
1. Gradual drying of wetland basin with 25-50% permanent water by August 1	10	
2. Gradual drying of wetland basin with 10 - 25% permanent water by August 1	8- 9	
3. Gradual drying of wetland basin with 50-75% permanent water by August 1	6- 7	
4. Gradual drying of wetland basin with greater than 75% permanent water by August 1	4- 5	
5. Stable summer water levels or rapid drying with less than 10% permanent water by August 1 and dry, hard substrate	2- 3	
6. No water after June 1	1	
(NOTE: If characteristic III scores a 1 disregard other criteria and enter .1 as Habitat Type Suitability Index).		
IV. Percent Nonforested Wetlands in Sample Unit (2000 Ac.)		IV.___
1. More than 75% (>1500 Ac.)	10	
2. 50 - 75% (1000 - 1500 Ac.)	8- 9	
3. 25 - 50% (500 - 1000 Ac.)	5- 7	
4. 10 - 25% (200 - 500 Ac.)	2- 4	
5. Less than 10% (<200 Ac.)	1	
V. Open Water Distribution		V.___
1. Open water areas interspersed within emergent vegetation	6-10	
2. Open water occurring as one or few pools	1- 5	
VI. Woody Invasion (% wetland covered by trees and shrubs)		VI.___
1. Less than 10%	10	
2. 10 - 25%	7- 9	
3. 25 - 50%	5- 6	
4. 50 - 75%	2- 4	
5. More than 75%	1	
VII. Water Depth 1 - 18" Deep (% wetland April 15 - August 1, average conditions)		VII.___
1. 25 - 50%	9-10	
2. 50 - 75%	6- 8	
3. Less than 25%	3- 5	
4. More than 75%	1- 2	

Evaluation Element: LEAST BITTERN Habitat Type: NONFORESTED WETLAND

CHARACTERISTIC	POSSIBLE SCORE	ACTUAL SCORE
VIII. Distance to Nonforested Wetland		VIII.___
1. Less than 250' to wetland with gradually drying basin and sedges or smartweeds covering more than 50% of the wetland basin.	10	
2. 250' to 660' to wetland with gradually drying basin and sedges or smartweeds covering more than 50% of wetland basin.	8- 9	
3. Less than 250' to wetland with gradually drying basin and sedges or smartweeds covering less than 50% of the wetland basin.	6- 7	
4. 250' to 660' to wetland with gradually drying basin and sedges or smartweeds covering less than 50% of the wetland basin.	4- 5	
5. Less than 660' to wetland with stable summer water levels; rapidly drying soils during the April 15 to September 1 period; or dominated by cattails or bulrush.	2- 3	
6. More than 660' to wetland.	1	

$$\frac{\text{Total Actual Score}}{\text{Maximum Potential Score (75)}} = \text{Habitat Type Suitability Index}$$

LESSER YELLOWLEGS
(Tringa flauipes)

Geographic Distribution

Present: Common migrant throughout the state.

Historical: Common statewide migrant.

General Habitat

The lesser yellowlegs is a common migrant shorebird. It can likely be found in most nonforested wetlands during the late spring or early fall wherever mudflats are interspersed with shallow water. This bird is also attracted to the margins of lakes and ponds as well as wet areas in cultivated fields.

Reproduction

The lesser yellowlegs breed in central Canada and winters in the southern half of South America. Occasionally, some birds will winter in southern Louisiana or Florida. Spring migrants will occasionally arrive in late March but most birds pass through the state in April and early May. Early fall migrants will arrive in Missouri at the end of July and late arrivals may pass through the state as late as mid-October.

Food

The most important food items are insects and small crustaceans. Small fish, reptiles and amphibians are also taken. Feeding is generally confined to shallow water areas or mudflats; however, wet areas in cultivated fields or pastures are also used.

Land Management

Lesser yellowlegs will not use wetlands covered with dense, tall vegetation. Optimum water depth is less than 2 1/2 inches with mudflats (exposed saturated soil) interspersed with water. Decaying vegetation provides a good substrate for insects and amphibians that serve as food. Most activity occurs at the shoreline to 25 feet from the shoreline.

Slow spring drawdowns 1 to 2 inches per week, beginning in late April will benefit lesser yellowlegs. Once the soil dries, feeding conditions are less attractive to these birds. Habitat conditions can be provided over the migration period in a single wetland unit by gradually lowering the water 1 to 2 inches per week. The wetland can be slowly reflooded and then dewatered if the soil dries. Alternatively, habitat conditions can be provided by staggering drawdown dates in several wetland units. Lesser yellowlegs will move to an adjacent wetland if habitat is more favorable.

Population Density

5 birds per acre

Limiting Factor

Mudflats or shallow water

References

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Evaluation Element: LESSER YELLOWLEGS

Habitat Type: NONFORESTED WETLAND
(Spring Habitat April 15 - June 1)
(Fall Habitat August 1 - September 15)

CHARACTERISTIC	POSSIBLE SCORE	ACTUAL SCORE
I. Water Depth 1" - 4" Deep (% wetland, average conditions)		I.____
1. More than 90%	9-10	
2. 75 - 90%	7- 8	
3. 50 - 75%	5- 6	
4. 25 - 50%	3- 4	
5. Less than 25%	1- 2	
II. Water Depth >4" Deep (% wetland, average conditions)		II.____
1. Less than 10%	9-10	
2. 10 - 25%	7- 8	
3. 50 - 75%	5- 6	
4. 75 - 90%	3- 4	
5. More than 90%	1- 2	
III. Wetland Size (Acres)		III.____
1. More than 200 acres	5	
2. 40 - 200 acres	2- 4	
3. Less than 40	1	
(NOTE: If characteristics I and III or II and III score a 1, disregard other criteria and enter .1 as Habitat Type Suitability Index.)		
IV. Water Fluctuation (Change in water depth)		IV.____
1. Gradually decreasing or increasing water level of <4" per week	8-10	
2. Gradually decreasing or increasing water level of 4" to 6" per week	5- 7	
3. Gradually decreasing or increasing water level of 6" to 8" per week	2- 4	
4. Rapid falling water levels of more than 4" per week; unpredictable water depths; or stable water levels	1	
V. Wetland Substrate		V.____
1. Muddy	5	
2. Sandy to muddy	2- 4	
3. Gravel	1	
VI. Soil Saturation (% exposed wetland substrate with water logged soils)		VI.____
1. More than 90% substrate waterlogged; less than 10% substrate dried	9-10	
2. 75 - 90% substrate waterlogged; 25 - 10% substrate dried	7- 8	
3. 50 - 75% substrate waterlogged; 50 - 25% substrate dried	5- 6	
4. 25 - 50% substrate waterlogged; 75 - 50% substrate dried	3- 4	
5. Less than 25% substrate waterlogged; more than 75% substrate dried	1- 2	
VII. Decaying Vegetation (% exposed wetland substrate and 1 - 4" shallow water areas covered by decaying herbaceous and woody vegetation).		VII.____
1. 50 - 75%	5	
2. 25 - 50%	2- 4	
3. Less than 25% or more than 75%	1	

Evaluation Element: LESSER YELLOWLEGS

Habitat Type: NONFORESTED WETLAND
(Spring Habitat April 15 - June 1)
(Fall Habitat August 1 - September 15)

CHARACTERISTIC	POSSIBLE SCORE	ACTUAL SCORE
VIII. Herbaceous and Woody Vegetation (% exposed wetland substrate and 1" - 4" shallow water areas covered by persistent emergent or other herbaceous or woody vegetation).		VIII.____
1. Less than 10%	10	
2. 10 - 25%	8- 9	
3. 25 - 50%	6- 7	
4. 50 - 75%	4- 5	
5. 75 - 90%	2- 3	
6. More than 90%	1	
(NOTE: If characteristic VIII scores a 1, disregard other criteria and enter .1 as Habitat Type Suitability Index.)		
IX. Substrate - Surface Water Interspersion		IX. ____
1. Exposed substrate interspersed with shallow water areas	6-10	
2. Shallow water areas occurring as one or few pools	1- 5	
X. Percent Nonforested Wetlands in Sample Unit (2000 Ac.)		
1. More than 75% (>1500 Ac.)	10	
2. 50 - 75% (1000 - 1500 Ac.)	8- 9	
3. 25 - 50% (500 - 100 Ac.)	5- 7	
4. 10 - 25% (200 - 500 Ac.)	2- 4	
5. Less than 10% (<200 Ac.)	1	

$$\frac{\text{Total Actual Score}}{\text{Maximum Potential Score (85)}} = \text{Habitat Type Suitability Index}$$

MUSKRAT
(Ondatra zibethicus)

Geographic Distribution

Present: Occurs statewide but only where wetlands exist.

Historical: Occurred statewide but more abundant before the majority of the state's wetlands were drained and converted to other uses.

General Habitat

The muskrat is one of Missouri's most common furbearing mammals; however, it has always been more abundant in its range north of Missouri. Muskrats live in sloughs, streams, rivers, oxbows, lakes and marshes. They prefer still or slowly moving water interspersed with emergent vegetation. Muskrats usually build dens in banks, but in emergent marshes, dens are made with aquatic vegetation anchored to the bottom of the wetland. Muskrats will excavate around the base of houses built in marshes and even dig canals if water levels drop. Muskrats are generally not social animals. Houses or dens are usually more than 25 feet apart and support 1 pair. Dispersal of young occurs in August. During periods of drought muskrats will live in woodchuck borrows or other dens until permanent water is available.

Reproduction

Breeding begins in late winter and extends through September with most activity March through May. Litters average 4 to 7 young in size with occasionally up to 5 litters produced annually. Two to 3 litters are produced annually. Weaning takes place in 3 to 4 weeks and the young move 10 to 60 yards to establish a new den. A major cause of mortality in the young is drowning when water levels rise.

Home ranges of muskrats are approximately 150 to 200 feet in diameter. Stream habitat or ditch banks will support one pair per 1,200 feet under optimum conditions.

Food

Muskrats tend to eat the most common food plants available. Important food plants include cattail, bulrush, arrowhead, sweetflag, sedge, wild rice, pickeralweed, lotus seeds and corn. Pondweed also forms a significant portion of the summer diet. Muskrats are primarily herbivores but individuals occuring in Ozark streams will eat clams, snails, crayfish, frogs and carrion.

In areas lacking emergent vegetation, muskrats will eat bluegrass, white clover, wild cherry and cheatgrass. During the winter muskrats will eat the roots of aquatic plants, dried grasses, stems of cattails, agricultural crops and carrion.

Land Management

Muskrats require permanent water preferring still or sluggish conditions. Water stability is more important than water depth. Fluctuations of 2 to 5 feet disrupt muskrat populations and cause animals to disperse. Low water levels coupled with subfreezing temperatures freeze food sources and close travel routes.

Optimum water levels vary with topography and vegetation type. Muskrats inhabiting streams prefer holes and backwaters while muskrats using marshes prefer water 12 to 18 inches deep. Greatest muskrat densities can be achieved in marshes with emergent vegetation. Cattails can support nearly twice the density of muskrats

than other vegetation. However, for ponds there is no correlation between muskrat numbers and vegetation. Stream habitat for muskrats can be enhanced with overhanging trees, undercut banks, and root tangles. In addition, clay banks provide good denning sites. Banks with more than 70 percent sand are avoided.

Marshes managed for muskrats should have more than 75 percent canopy coverage of cattails or bulrush. Woody invasion should be less than 5 percent canopy coverage. Summer and winter water levels should be as stable as possible. Optimum wetland size is 200 acres or greater. Open water is not necessary for muskrats but habitat deterioration may result as number of animals increase. Muskrat damage to levees can be minimized by constructing 4 to 1 slopes. Muskrats are attracted to permanent marshes in mid-successional stages and management must eventually be directed at turning back succession usually with dewatering and soil disturbance.

Population Density with Optimum Habitat

2 pair per acre of marsh
1 pair per 1,200 feet of stream bank

Limiting Factor

Stable summer water
Emergent vegetation

References

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Evaluation Element: MUSKRAT Habitat Type: NONFORESTED WETLAND

CHARACTERISTIC	POSSIBLE SCORE	ACTUAL SCORE
I. Winter Water Fluctuations (September 1 - April 15)		I.____
1. Stable	10	
2. Less than 4"	7- 9	
3. 4 - 10"	4- 6	
4. 10 - 18"	2- 3	
5. More than 18"; or unpredictable water levels	1	
(NOTE: If characteristic I scores a 1, disregard other criteria and enter .1 as Habitat Type Suitability Index.)		
II. Water Regime (% of wetland covered by permanent water, entire year, average conditions).		II.____
1. More than 90%	10	
2. 75 - 90%	7- 9	
3. 50 - 75%	5- 6	
4. 25 - 50%	3- 4	
5. Less than 25%	1- 2	
III. Open Water (% wetland occurring as permanent open water without emergent, woody, or annual vegetation).		III.____
1. Less than 10%	10	
2. 10 - 25%	7- 9	
3. 25 - 50%	5- 6	
4. 50 - 90%	2- 4	
5. More than 90%	1	
IV. Wetland Size (Acres)		IV.____
1. More than 200 Acres	10	
2. 100 - 200 Acres	6- 8	
3. 40 - 100 Acres	4- 5	
4. 10 - 40 Acres	2- 3	
5. Less than 10 Acres	1	
V. Cattail and Bulrush Coverage (% wetland covered by cattails and bulrush)		V.____
1. More than 75%	10	
2. 50 - 75%	7- 9	
3. 25 - 50%	5- 6	
4. 10 - 25%	2- 4	
5. Less than 10%	1	
VI. Percent Nonforested Wetlands in Sample Unit (2000 Ac.)		VI.____
1. More than 75% (1500 Ac.)	10	
2. 50 - 75% (1000 - 1500 Ac.)	8- 9	
3. 25 - 50% (500 - 1000 Ac.)	5- 7	
4. 10 - 25% (200 - 500 Ac.)	2- 4	
5. Less than 10% (200 Ac.)	1	
VII. Woody Invasion (% wetland covered by trees and shrubs).		VII.____
1. Less than 10%	5	
2. 10 - 25%	4	
3. 25 - 50%	3	
4. 50 - 75%	2	
5. More than 75%	1	
VIII. Summer Water Fluctuation in Persistent Emergent Vegetation (Change in water depth April 15 - September 1).		VIII.____
1. Less than 6"	7-10	
2. 6" - 1'	6- 8	
3. 1' - 1½'	2- 5	
4. More than 1½' or more than 75% moist or dry soil during all or a portion of April 15 - September 1 period	1	
(NOTE: If characteristic VIII scores a 1, disregard other criteria and enter .1 as Habitat Type Suitability Index.)		

IX. Winter Water Depth Persistent Emergent Vegetation (Average conditions September 1 - April 15) IX. ____

1. 15 - 24"	8-10
2. 10 - 15" or 24 - 30"	5- 7
3. 6 - 10" or 30 - 36"	2- 4
4. Less than 6" or more than 36"	1

$$\frac{\text{Total Actual Score}}{\text{Maximum Potential Score (85)}} = \text{Habitat Type Suitability}$$

(NOTE: Multiply HTSI by the percent of the wetland covered by permanent water. Enter this figure or .1, whichever is greater as final HTSI.)

KING RAIL
(Rallus elegans)

Geographic Distribution

Present: Casual summer resident with reported sightings in only 13 counties but well distributed throughout the state where wetlands exist.

Historical: Probably more abundant before the majority of the state's wetlands were converted to agricultural purposes. In addition, turbid water in most of Missouri's major rivers adversely affects emergent vegetation and thus king rail numbers.

General Habitat

The king rail is a wetland nesting bird requiring shallow water or saturated soils during the growing season, April 15 to August 1. Dense stands of sedges are preferred for nesting and feeding but dense areas of smartweeds are also used. This bird is classified as rare in Missouri.

Reproduction

Nesting peaks in Missouri during May. Incubation requires 21 to 22 days and clutch size averages 12 eggs. Both male and female remain with the brood for up to one month after hatching.

Robust sedges (Carex spp.) are the preferred nest substrate but dense smartweeds from the previous winter are also used. Cattail and river bulrush dominated marshes are avoided. Nests are built in sedges growing on saturated soils or shallow water less than 18 inches deep. Occasionally, nesting occurs in grasses at the wetland edge as well as on ditch banks or levees with grass cover.

Food

Animal matter constitutes 79 percent of the adult diet. Crayfish is an important food. Broods are attracted to saturated soils and probe the substrate for insects.

Land Management

The king rail in Missouri prefers wetlands associated with riverine flood plain systems. Gradual drying of the wetland basin during the brood rearing season (May through July) is important. Adults may forage by clinging to wetland vegetation over water with their feet but the young require saturated soil or shallow water for feeding.

Sedge wetlands used for nesting should have vegetation greater than 1 foot tall. Wetlands used for feeding may have vegetation 2 to 4 feet tall during the May through June period. Feeding sites may be dominated by smartweeds. King rails tolerate woody invasion by willow, buttonbush or other species associated with riverine wetlands.

Nesting activity can be concentrated in a small wetland dominated by sedges if adjacent brood rearing habitat exists consisting of gradually exposed saturated

substrate with insect food sources. Small wetlands with sedges for nesting surrounded by agricultural land or woodland are not attractive nest sites because of the lack of brood rearing habitat.

Brood rearing habitat can be maintained by staggering water drawdown in adjacent wetlands. Broods will move to wetlands with saturated, exposed soil or with shallow water.

Population Densities

1 breeding pair per 15 acres

Limiting Factor

Wetlands with shallow water or saturated soils
Wetlands dominated by robust sedges

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Evaluation Element: KING RAIL — Habitat Type: NONFORESTED WETLAND

CHARACTERISTIC	POSSIBLE SCORE	ACTUAL SCORE
I. Sedge Canopy Coverage (% wetland covered by sedges)		I.___
1. 75 - 90%.	10	
2. More than 90%	8- 9	
3. 50 - 75%.	6- 7	
4. 25 - 50%.	4- 5	
5. Less than 25%	2- 3	
6. None.	1	
(Note: If characteristic I scores a 1, disregard other criteria and enter .1 as Habitat Type Suitability Index)		
II. Water Regime (% wetland covered by permanent water, April 15 - August 1, average conditions)		II.___
1. Gradual drying of wetland basin with 25-50% permanent water by August 1	10	
2. Gradual drying of wetland basin with 10 - 25% permanent water by August 1	7- 9	
3. Gradual drying of wetland basin with 50-75% permanent water by August 1	5- 6	
4. Gradual drying of wetland basin with greater than 75% permanent water by August 1	2- 4	
5. Stable summer water levels or rapid drying with less than 10% permanent water by August 1 and dry, hard substrate	1	
III. Wetland Size (Acres)		
1. More than 100 acres	5	
2. 75 - 100 acres.	4	
3. 50 - 75 acres	3	
4. 20 - 50 acres	2	
5. Less than 20 acres.	1	
IV. Water Depth 1 - 18" Deep (% wetland April 15 - August 1, average conditions)		IV.___
1. 25 - 50%.	9-10	
2. 50 - 75%.	6- 8	
3. Less than 25%	3- 5	
4. More than 75%	1- 2	
V. Woody Invasion (% wetland covered by trees or shrubs)		V.___
1. 25 - 50%.	9-10	
2. 10 - 25%.	7- 8	
3. Less than 10%	5- 6	
4. 50 - 75%.	3- 4	
5. More than 75%	1- 2	
VI. Average Height of Emergent Vegetation Above Water (April 15 - August 1)		VI.___
1. 1' - 2'	5	
2. 2' - 3'	4	
3. More than 3'.	2- 3	
4. Less than 1'.	1	
VII. Emergent Vegetation Species Composition (% wetland covered by cattails and bulrush)		VII.___
1. Less than 25%	5	
2. 25 - 50%.	4	
3. 50 - 75%.	2- 3	
4. More than 75%	1	
(Note: If characteristic VII scores a 1, disregard other criteria and enter .1 as Habitat Type Suitability Index)		

Evaluation Element: KING RAIL Habitat Type: NONFORESTED WETLAND

CHARACTERISTIC	POSSIBLE SCORE	ACTUAL SCORE
VIII. Percent Nonforested Wetlands within Sample Unit (2000 Ac.)		VIII.___
1. More than 75% (>1500 ac.)	10	
2. 50 - 75% (1000 - 1500 Ac.)	8- 9	
3. 25 - 50% (500 - 1000 Ac.)	5- 7	
4. 10 - 25% (200 - 500 Ac.)	2- 4	
5. Less than 10% (<200 Ac.)	1	
IX. Distance to Nonforested Wetland		IX.___
1. Less than 250' to wetland with gradually drying basin and sedges or smartweeds covering more than 50% of the wetland basin	10	
2. 250' to 660' to wetland with gradually drying basin and sedges or smartweeds covering more than 50% of wetland basin	8- 9	
3. Less than 250' to wetland with gradually drying basin and sedges or smartweeds covering less than 50% of the wetland basin	6- 7	
4. 250' to 660' to wetland with gradually drying basin and sedges or smartweeds covering less than 50% of the wetland basin	4- 5	
5. Less than 660' to wetland with stable summer water levels; rapidly drying soils during the April 15 to September 1 period; or dominated by cattails or bulrush.	2- 3	
6. More than 660' to wetland.	1	

$$\frac{\text{Total Actual Score}}{\text{Maximum Potential Score (75)}} = \text{Habitat Type Suitability Index}$$

GREEN-BACKED HERON
(Butorides striatus)

Geographic Distribution

Present: A common migrant and summer resident throughout Missouri.

Historical: Also commonly distributed throughout the state.

General Habitat

Green-backed herons inhabit a wide range of wetland habitats including streamsides, nonforested wetlands, oxbows and other depressions in lowland forests. These bird inhabit the edges between wetlands and uplands and forage in openings among emergent vegetation and in shallow water bordering woodlands.

Reproduction

Green-backed herons are late migrants arriving in late April. March sightings are unusual. Egg laying can extend from May to July with peak egg laying from mid-May to mid-June. Clutch size averages 2 to 5 eggs. Both sexes participate in the 20-day incubation period.

The fall migration is not fully described for Missouri. Green-backed herons do not form massive concentrations during the fall. Peak counts of these birds occur from mid-August to mid-September with very few sightings after the first of October.

Green-backed herons are solitary nesters but occasionally they are found in small colonies or scattered pairs. Nesting usually occurs over or adjacent to water. Nests are usually built in small trees or bushes 3 to 18 feet off the ground. Willows provide a common nesting substrate. Nests can also be built on muskrat houses or tussocks. In nonforested wetlands, emergent vegetation is used to build nests. Small breeding and foraging territories from 160 to 1,000 square yards are defended.

Food

Small fish and crustaceans are the most frequently taken food. Insects are also important.

Land Management

The management of nonforested wetlands for green-backed herons should emphasize woody inclusions and borders. Permanent water from April 15 to September 1 is essential. Nonforested wetlands should be more than 40 acres in size and associated in a wetland complex consisting of adjacent forested wetlands. Permanent water in the form of oxbows, streams, small pools or shallow depressions will enhance forested wetlands for green-backed herons.

Green-backed herons usually confine their use of forested wetlands to edges with water. These birds prefer forests with openings and permanent water for foraging. Lowland hardwoods without water during the growing season are unattractive to green-backed herons. Fallen logs, amphibians, small fish and insects will enhance utilization by green-backed herons.

Population Density

1 bird per 5 acres

Limiting Factor

Stable summer water

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Evaluation Element: GREEN-BACKED HERON Habitat Type: NONFORESTED WETLAND

CHARACTERISTIC	POSSIBLE SCORE	ACTUAL SCORE
I. Water Regime (% wetland covered by permanent water, April 15 - September 1, average conditions).		I.___
1. More than 90%	10	
2. 75 - 90%	7- 9	
3. 50 - 75%	5- 6	
4. 25 - 50%	3- 4	
5. 10 - 25%	2	
6. Less than 10%	1	
(NOTE: If characteristic I scores a 1, disregard other criteria and enter .1 as Habitat Type Suitability Index)		
II. Wetland Size (Acres)		II.___
1. More than 40 acres	5	
2. 5 - 40 acres	2- 4	
3. Less than 5 acres	1	
III. Percent Forested and Nonforested Wetlands within Sample Unit (2000 Ac.)		III.___
1. More than 75% (>1500 Ac.)	10	
2. 50 - 75% (1000 - 1500 Ac.)	8- 9	
3. 25 - 50% (500 - 1000 Ac.)	5- 7	
4. 10 - 25% (200 - 500 Ac.)	2- 4	
5. Less than 10% (<200 Ac.)	1	
IV. Emergent Vegetation Coverage (% wetland covered by cattails, bulrush, spikerush, burreed, sweetflag and smartweeds).		IV.___
1. 25 - 50%	5	
2. 10 - 25%	4	
3. 50 - 75%	2- 3	
4. Less than 10% or more than 75%	1	
V. Water Depth 1" - 18" Deep (% wetland April 15 - September 1, average conditions).		V.___
1. More than 75%	5	
2. 50 - 75%	4	
3. 25 - 50%	2- 3	
4. Less than 25%	1	
VI. Loafing Sites (% wetland occurring as bare ground, shallow water areas 1" deep, mounds, mudflats, muskrat mounds, etc. April 15 - September 1)		VI.___
1. 5 - 10% scattered throughout wetland	5	
2. 10 - 20% scattered throughout wetland	3- 4	
3. Mainly along periphery of wetland	2	
4. Less than 5% or more than 20%	1	
VII. Distance to Forested Wetland or Riparian Woodland		VII.___
1. Less than 1/4 mile	5	
2. 1/4 - 1/2 mile	2- 4	
3. More than 1/2 mile	1	
VIII. Distance to Stream or River with Permanent Pools or Flowing Water during Summer.		VIII.___
1. Less than 1/4 mile	5	
2. 1/4 - 1/2 mile	2- 4	
3. More than 1/2 mile	1	
IX. Woody Invasion (% wetland covered by trees and shrubs)		IX.___
1. 50 - 75%	9-10	
2. 25 - 50%	7- 8	
3. 10 - 25% or 75 - 90%	4- 6	
4. More than 90%	2- 3	
5. Less than 10%	1	

X. Wetland Edge X.____

1.	More than 75% of edge with forested wetland or woody vegetation	9-10
2.	50 - 75% of edge with forested wetland or woody vegetation	7- 8
3.	25 - 50% of edge with forested wetland or woody vegetation	5- 6
4.	10 - 25% of edge with forested wetland or woody vegetation	3- 4
5.	<10% of edge with forested wetland or woody vegetation	1- 2

(NOTE: If characteristics IX and X score a 1, disregard other criteria and enter .1 as Habitat Type Suitability Index)

$$\frac{\text{Total Actual Score}}{\text{Maximum Potential Score (70)}} = \text{Habitat Type Suitability Index}$$

Evaluation Element: GREEN-BACKED HERON Habitat Type: FORESTED WETLAND

CHARACTERISTIC	POSSIBLE SCORE	ACTUAL SCORE
I. Permanent Water Within Stand (% of stand covered by oxbows, old channels, vernal ponds, or shallow depressions)		I.___
1. More than 50%	8-10	
2. 25 - 50%	5- 7	
3. 10 - 25%	2- 4	
4. Less than 10%	1	
II. Wetland Size (Acres)		II.___
1. More than 40 acres	5	
2. 5 - 40 acres	2- 4	
3. Less than 5 acres	1	
(NOTE: If characteristics I and II score a 1, disregard other criteria and enter .1 as Habitat Type Suitability Index.)		
III. Water Depth 1" - 18" Deep (% wetland April 15 - September 1, average conditions)		III.___
1. More than 75%	5	
2. 50 - 75%	4	
3. 25 - 50%	2- 3	
4. Less than 25%	1	
IV. Openings (% of stand with less than 10% canopy closure)		IV.___
1. More than 50%	8-10	
2. 25 - 50%	5- 7	
3. 10 - 25%	2- 4	
4. Less than 10%	1	
V. Percent Forested and Nonforested Wetlands Within Sample Unit (2000 Ac.)		V.___
1. More than 75% (>1500 Ac.)	10	
2. 50 - 75% (1000 - 1500 Ac.)	8- 9	
3. 25 - 50% (500 - 1000 Ac.)	5- 7	
4. 10 - 25% (200 - 500 Ac.)	2- 4	
5. Less than 10% (<200 Ac.)	1	
VI. Distance to Stream or River with Permanent Pools or Flowing Water during Summer		VI.___
1. Less than 1/4 mile	5	
2. 1/4 - 1/2 mile	2- 4	
3. More than 1/2 mile	1	

$$\frac{\text{Total Actual Score}}{\text{Maximum Potential Score (45)}} = \text{Habitat Type Suitability Index}$$

APPENDIX A
ACTUAL SCORE MATRIX

This appendix outlines the method utilized for adjusting present habitat values for various plan conditions. The actual score matrix displays the existing field scores by species and habitat type for each model characteristic. The matrix for the mallard is included as example.

The actual score matrix is used as follows: The mallard was used to evaluate 3 habitat types. The habitat types and model characteristics are listed on the left side of the matrix. The possible field scores occur at the top of the matrix. Existing conditions for each characteristic can be scored on a 1 to 10 or 1 to 5 scale. In the cropfield habitat type, one of the model characteristics is land management. A total of 6 cropfields were sampled. The land management characteristic scored as 1 four times and as 5 two times for a total of 14 points out of a total possible of 60 and a habitat characteristic index of .23.

Comparisons between alternate plans can be made by comparing the different habitat characteristic indexes. The habitat type suitability indexes for the alternate plans can be calculated by adjusting scores at each sample site to reflect the different plan conditions. Then new actual score matrixes can be constructed and the effects of the plans on individual characteristics displayed and comparisons drawn.

ACTUAL SCORE MATRIX
(Example)

SPECIES: MALLARD

	Maximum Characteristic Score	1	2	3	4	5	6	7	8	9	10	Characteristic Suitability Index
NONFORESTED WETLAND Total Samples = 11												
Fall-Winter Flood Freq.	10						2	1			8	.90
Fall-Winter Flood Cond.	10						2	1			8	.90
% Forested-Nonforested Wetl.	10	7		3								.45
Water Depth 1"-18"	10	2			2				2	2	3	.67
Important Food Coverage	10	5	4	1		1						.19
Average Ht. Seed Plants	5	7		1		3						.45
No. Import. Food Plants	5			1	10							.98
Winter Cover	5	5	1	4		1						.44
Loafing Sites	5					11						1.00
Open Water	5	7		1		3						.45
Dist. Forested Wetl.	10	11										.10
Dist. Cropland	10					5					6	.85
FORESTED WETLAND Total Samples = 10												
Fall-Winter Flood Freq.	10										10	1.00
Fall-Winter Flood Cond.	10	2		2		6						.38
% Forested-Nonforested Wetl.	10	6	2	1	1							.17
Water Depth 1"-18"	10	6	1	1		1		1				.73
Import. Food Coverage	10	1	2	1		6						.38
No. Import. Food Plants	5	5	1	1	1	2						.48
Tree Size Class	10	2		2		6						.38
Overstory Composition	10	3				7						.38
Permanent Water in Stand	5	3				7						.76
Openings	5					10						1.00
Dist. Nonforested Wetl.	10	10										.10
Dist. Cropland	10					5					5	.75
CROPLAND Total Samples = 6												
Fall-Winter Flood Freq.	10					2					4	.83
% Forested-Nonforested Wetl.	10	4				2						.23
Water Depth 1"-18"	10			1		2		1	1	1		.62
Land Management	10	4				2						.23
Cropping Practices	10					1		1	3	1		.75
Dist. Forested Wetl.	10	3		1		1	1					.28
Dist. Nonforested Wetl.	10	3		1		2						.27

APPENDIX B
ANIMAL DENSITY ESTIMATES

These animal numbers and animals per habitat unit were developed for Missouri wetlands statewide and are estimated numbers of animals per unit area for optimum (1.0) habitat. These numbers should be adjusted if more local information is available.

The density estimates for the mallard, lesser yellowlegs and Canada goose were difficult to establish. The models for these species evaluate fall and winter migratory habitat. Weather conditions on the Canadian breeding grounds in the fall as well as weather conditions on migration routes north of Missouri can influence bird numbers. Hunting pressure and weather conditions in Missouri can affect migratory bird densities.

For all the wetland species described in this handbook, population densities can fluctuate dramatically from year to year depending on water conditions and vegetation. The animal densities presented here must be considered long term averages rather than what could be expected in any one season.

Habitat Units (HU) Per Animal Expected to Occur with an Optimum Habitat Rating of 1.0[1]

Species	Optimum Densities and Animals Per HU
Mallard	10 birds per acre or 10 birds per HU
Canada Goose	4 birds per acre or 4 birds per HU
Muskrat	2 pair per acre or 4 animals per HU 1 pair per 1200 feet of stream bank or 1 HU per 600 feet of stream bank
Least Bittern	1 pair per 2 acres or 1 bird per HU
Lesser Yellowlegs	5 birds per acre or 5 birds per HU
Green-backed Heron	1 bird per 5 acres or .20 birds per HU
King Rail	1 pair per 15 acres or .13 birds per HU

1. Represents statewide averages and optimum densities should be adjusted based on known densities in the vicinity.